

INCH- POUND

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MILITARY SPECIFICATION
SWITCHES, ROTARY, MULTIPOLE AND SELECTOR,
GENERAL SPECIFICATION FOR

This specification is approved for use by the Naval Sea Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1 SCOPE

1.1 Scope This specification covers the general requirements for closed construction rotary multipole and selector switches which are able to make, break, and carry electrical loads up to and including 10 amperes

1.2 Classification. Switches shall be classified as specified in the applicable specification sheet (see 3.1 and 6.6).

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2)

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to Commander, Naval Sea Systems Command, SEA 5523, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter

AMSC N/A

FSC 5930

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SPECIFICATIONS

FEDERAL

- QQ-B-750 - Bronze, Phosphor; Bar, Plate, Rod, Sheet, Strip, Flat Wire, and Structural and Special Shaped Sections
- QQ-C-576 - Copper, Flat Products With Slit, Slit and Edge-Rolled, Sheared, Sawed, or Machined Edges (Plate, Bar, Sheet and Strip)
- QQ-N-290 - Nickel Plating (Electrodeposited)
- QQ-S-365 - Silver Plating, Electrodeposited. General Requirements for
- PPP-F-320 - Fiberboard· Corrugated and Solid, Sheet Stock (Container Grade) and Cut Shapes

MILITARY

- MIL-M-14 - Molding Plastics and Molded Plastic Parts, Thermosetting.
- MIL-T-152 - Treatment, Moisture and Fungus Resistant, of Communications, Electronic, and Associated Electrical Equipment
- MIL-A-8625 - Anodic Coatings, for Aluminum and Aluminum Alloys.
- MIL-P-15035 - Plastic Sheet· Laminated, Thermosetting, Cotton-Fabric-Base, Phenolic-Resin
- MIL-P-15037 - Plastic Sheet, Laminated, Thermosetting, Glass-Cloth, Melemine-Resin
- MIL-L-19140 - Lumber and Plywood, Fire Retardant Treated
- MIL-G-23827 - Grease, Aircraft and Instrument, Gear and Actuator Screw, NATO Code Number G-354, Metric.
- MIL-S-28786 - Switches, Packaging of.
- MIL-C-83488 - Coating, Aluminum, Ion Vapor Deposited
- MIL-C-87115 - Coating, Immersion Zinc Flake/Chromate Dispersion

STANDARDS

FEDERAL

- FED-STD-H28 - Screw-thread Standards for Federal Services
- FED-STD-595 - Colors

MILITARY

- MIL-STD-167-1 - Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type II - Internally Excited).
- MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts
- MIL-STD-454 - Standard Requirements for Electronic Equipment
- MIL-STD-1285 - Marking of Electrical and Electronic Parts
- MIL-STD-45662 - Calibration Systems Requirements.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094

2.2 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

B 633 - Standard Specification for Electrodeposited
Coatings of Zinc on Iron and Steel. (DoD adopted)

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between requirements of this specification and the specification sheet, the latter shall govern.

3.2 Qualification Switches furnished under this specification shall be products which are authorized by the qualifying activity for listing on the applicable qualified products list at the time of award of contract (see 4.5 and 6.4).

3.3 Switch types. Switches furnished under this specification shall be as defined in 3.3.1 and 3.3.2.

3.3.1 Switches covered by specification sheet and identified by type designation. Switches which are completely defined by a military specification sheet (see 3.1), and switches differing from the specification sheet only in the number of sections and having a number of sections within the minimum and maximum number shown on the specification sheet, shall be as specified in 6.2.

3.3.2 Switch types not shown on a specification sheet Where the applicable specification sheet does not show a specific switch type (see 3.3.1), the individual part requirements shall be as specified (see 6.2). The switches shall be a product of the basic style, design and construction as the switches shown on the specification sheets and shall be acquired from a source listed on the qualified products list for the same specification sheet (see 3.2). Unless otherwise specified (see 6.2) the individual switch shall comply with the inspection requirements shown in 4.6.

3.4 Material. Material shall be as specified herein. When a definite material is not specified, a material shall be used which will enable the switches to meet the performance requirements of this specification (see 6.2). Acceptance of any constituent material shall not be construed as a guaranty of the acceptance of the finished product.

3.4.1 Metals. Metals shall be of sea water corrosion-resistant alloys or shall be plated with IVD aluminum with chromate treatment, type II, class 3 (plate thickness 0.0003 inch) in accordance with MIL-C-83488 immersion zinc flake/chromate dispersion, class 3 (plate thickness 0.0003 inch) in accordance with MIL-C-87115; zinc plated in accordance with class 2, type II of ASTM B 633; nickel plated in accordance with class 1, grade G of QQ-N-290 or anodized in accordance with MIL-A-8625 (aluminum alloys only), to resist corrosion. Aluminum shall not be used for structural parts and operating shaft.

3.4.1.1 Contact material and plating Unless otherwise specified (see 3.1 and 6.2), the movable (rotor) switch blade contact shall be composition A phosphor bronze in accordance with QQ-B-750. The stationary (stator) contacts shall be copper in accordance with QQ-C-576. Threaded holes shall have a minimum of three full threads. The electrical contact surfaces shall be silver plated in accordance with QQ-S-365. The moveable contact surface shall have an inlay or overlay of a minimum 0.002 inch of fine silver or silver alloy. The stationary electrical contact surface shall have a minimum thickness of 0.0001 inch.

3.4.1.2 Current-carrying parts Ferrous material or aluminum shall not be used for current-carrying parts, including terminal hardware.

3.4.1.3 Dissimilar metals When dissimilar metals are used in intimate contact with each other, protection against electrolysis and corrosion shall be provided. The use of dissimilar metals in contact, which tend toward active electrolytic corrosion (particularly copper alloys, copper, or steel used in contact with aluminum or aluminum alloy) is not acceptable. However, metal plating or metal spraying of dissimilar base metals to provide similar or suitable abutting surfaces is permitted. The use of dissimilar metals separated by a suitable insulating material is also permitted. Dissimilar metals are defined in 6.7 through 6.7.4.

3.4.1.4 Lubrication.

3.4.1.4.1 Detent mechanism. The detent mechanism and other mechanical moving parts shall be lubricated with a compound in accordance with MIL-G-23827.

3.4.1.4.2 Contacts. Contacts shall be lubricated with a compound in accordance with MIL-G-23827, or equal. The method for lubricating with contacts shall result in the application of a minute amount of lubrication on the contacts.

3.4.2 Insulation.

3.4.2.1 Plastic laminates. Unless otherwise specified (see 3.1 and 6.2), plastic laminates shall be in accordance with MIL-P-15035, type FBE or MIL-P-15037, type GME.

3.4.2.2 Plastic molding. Unless otherwise specified (see 3.1 and 6.2) plastic molding material shall be type MAI-30 or MAI-60 of MIL-M-14. Color shall be gray, approximating color chip number 26307 of FED-STD-595

3.4.2.3 Fungus-resistance. Insulation material shall be nonfungus nutrient in accordance with MIL-STD-454, requirement 4.

3.4.2.4 Flammable material. Insulation material shall be fire retardant in accordance with MIL-STD-454, requirement 3

3.4.2.5 Toxic and hazardous material Toxic and hazardous materials shall conform to requirement 1 of MIL-STD-454.

3.4.3 Recovered materials. Unless otherwise specified herein, all equipment, material, and articles incorporated in the products covered by this specification shall be new and may be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products is allowed under this specification unless otherwise specifically specified

3.5 Design and construction. Switches shall be of closed construction so that the switching mechanism and the switching contacts are fully enclosed (except terminals), to prevent foreign matter from entering the switch mechanism or interfering with the contacts. Switches shall be constructed to ensure proper operation when mounted in any position. The switches shall be of the design, construction, and physical dimensions specified (see 3.1) and the switch circuit configuration shall conform to the applicable rotor designation specified (see 3.1 and 6.2).

3.5.1 Threaded parts. Unless otherwise specified (see 3.1 and 6.2), threaded parts shall be in accordance with FED-STD-H28. Wherever possible, unified screw threads shall be used. Where a special diameter-pitch combination is required, the thread shall be of American National Form and of any pitch which is used in the fine-thread series.

3.5.1.1 Engagement of threaded parts Threaded parts shall engage at least three full threads in soft metals like aluminum and its alloys. A minimum of two full threads shall be used in harder materials such as brass or

steel. When a screw mates with a plastic part, a threaded metal insert shall be contained therein.

3 5 1.2 Locking of screw-thread assemblies. Unless otherwise specified (see 3 1), all screw-thread assemblies shall be rendered resistant to loosening under vibration. Unless otherwise specified (see 3.1), bronze, stainless steel or suitably plated steel split type, or internal-tooth lockwashers shall be provided under all nuts or screw heads. The use of locknuts is permitted in lieu of lockwashers.

3 5.1.3 Hardware.

3 5 1.3.1 Mounting hardware. The mounting hardware shall be as specified (see 3.1). Unless otherwise specified (see 6.2), mounting hardware shall be assembled in the proper order as shown on the applicable specification sheet for direct Government procurement or supplied un-assembled along with terminal hardware as specified (see 3 5.1 3.2).

3.5.1.3.2 Terminal hardware The terminal hardware shall be as specified (see 3.1 and 6.2). If the terminal hardware is not assembled to the switch, it shall be placed in a bag and firmly secured to the switch

3 5 1 3 3 Knobs. Unless otherwise specified (see 6 2), switches shall be provided with knobs as specified (see 3 1)

3.5.2 Stops. Switches shall be provided with adjustable stops as required (see 3.1) to limit switch positions. Screws and lockwashers required as parts of adjustable stops shall be placed in sturdy bags firmly attached to the switches unless otherwise specified (see 6.2).

3.5 3 Operating shaft. The shaft shall be steel and shall be insulated from all current-carrying members. The configuration and dimensions shall be as specified (see 3.1).

3.5 3.1 Perpendicularity of operating shaft (applicable to JR, JM, RJR and RJRA switches) For JR and JM switches with 15 decks or more, the plane generated by the mounting surfaces of the mounting pads shall be perpendicular to the operating shaft within 1 degree. For RJR and RJRA switches, the mounting surface shall be perpendicular to the centerline of the operating shaft, at the lock arm, within 0.055 inches.

3.5.3.2 Rotational float of shaft. For types RJR and RJRA switches, the rotational float of the operating shaft shall not exceed 3 degrees in the detent position before and after the endurance tests. For all other switches the rotational float of the operating shaft shall not exceed 6 degrees in the detent position before and after the endurance test.

3.5.3.3 Rotor and shaft alignment. The average opening and closing of contacts on adjacent switch wafers shall be within 3 degrees of each others at initial examination (see 4 8 9 4). Following endurance testing the average opening and closing of the same contacts shall be within 2 degrees of the initial measurements.

3 5.4 Terminals. The terminals shall be as specified (see 3.1 and 6 2).

3.5 4.1 Alignment (applicable to RJR and RJRA switches). For RJR and RJRA switches, the centerlines of the contact terminals in successive sections shall be in line with the centerline of the corresponding contact terminal in the first section within 0.020 inch

3 5.5 Indexing. Switches shall have a positive detent or indexing mechanism, locating each contact position, except when spring return action is specified (see 3 1). The positive detent or indexing mechanism shall be designed to minimize the possibility of the movable element or elements coming to rest between positions. Switches with spring return mechanism shall return from the full travel momentary position to the specified fixed position within +/- 5 degrees, including the movable elements, when the operating force is removed. Glass or other fragile materials shall not be used in detent or indexing mechanisms.

3 5.6 Contact mating The moveable switch blade contacts shall provide a firm wiping action and shall engage both sides of the stationary contacts at the contact engagement areas with a uniform positive pressure

3.5.7 Barriers. Unless otherwise specified (see 3 1), barriers shall be provided between current carrying terminals of adjacent decks and shall be of the diameter specified (see 3.1). Barrier material shall be FBE laminate in accordance with MIL-P-15035 or GME in accordance with MIL-P-15037. The barrier surface and edge finish shall be smooth and non-abrasive Varnish in accordance with MIL-T-152 shall be applied after any required marking has been applied to plastic laminate barriers.

3.6 Circuit configuration. Switches shall make and break the specified circuits in all positions of all sections (see 4.8.2) The making and breaking of circuits, in both momentary and detented positions, shall be positive. In switching break-before-make contact arrangement, the first contact fully breaks before the second contact is made In switching make-before-break contact, the second contact is closed before the first is open

3.7 Strength of mounting bushing (bushing mounted switches only). There shall be no damage to the switch, nonturn device, or loosening or twisting of the bushing relative to the switch front plate assembly (see 4.8.3).

3 8 Torque

3.8.1 Rotational The torque required to rotate the shaft from each detent position to the next shall be as specified (see 3 1 and 4 8 4) When applicable, the torque required to rotate the shaft into each momentary position shall be as specified (see 3.1 and 6.2).

3.8 2 Stops (applicable only to switches with stops) There shall be no broken, loose, deformed, or displaced parts, nor shall the contacts transfer from their proper condition (see 4.8.4.2).

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3.9 Terminal strength. The switch shall be able to operate mechanically and electrically (see 4.8.5). There shall be no short circuitry, breakage, or damage to the switch

3.10 Dielectric withstanding voltage Switches shall withstand the application of the specified voltages without arcing, breakdown of insulation, or damage, and there shall be no leakage current greater than 100 microamperes (see 4.8.6).

3.11 Insulation resistance. The insulation resistance shall be greater than 200 megohms (see 4.8.7)

3.12 Contact resistance. The contact resistance shall not exceed 10 milliohms (see 4.8.8).

3.13 Endurance. Switches shall be electrically and mechanically operative during and after the tests specified in 4.8.9.1 and 4.8.9.2, and the contact resistance shall not exceed 10 milliohms. Each mating contact shall make and break at the proper time throughout the test. After the test, there shall be no evidence of broken, loose, deformed, or displaced parts

3.14 Temperature rise. The temperature rise (see 4.8.10) shall be within the limits specified (see 3.1 and 6.2).

3.15 Vibration. There shall be no opening of closed contacts in excess of 10 microseconds (see 4.8.11) and there shall be no change in shaft position, or evidence of broken, loose, deformed, or displaced parts

3.16 Shock. Mating closed contacts shall not open for a period of time longer than 20 milliseconds and there shall be no change in shaft position, or evidence of broken, loose, deformed, or displaced parts (see 4.8.12)

3.17 Moisture resistance The insulation resistance, immediately after conclusion of the test specified in 4.8.13 and while the switches are still in the humidity chamber, shall be greater than 100 megohms. At the end of the drying period, the insulation resistance shall be greater than 100 megohms. At the conclusion of the test there shall be no evidence of corrosion, breaking, cracking, spalling or loosening of hardware, and the mounting and terminal hardware shall be readily removable

3.18 Salt spray (corrosion) There shall be no evidence of excessive corrosion (see 4.8.14). Excessive corrosion is defined as corrosion which interferes with the electrical or mechanical performance, or, in the case of plated metals, corrosion which has passed through the plating and exposed the base metal. After the test, mounting and terminal hardware shall be readily removable.

3.19 Seal (applicable to style JF switches only). There shall be no evidence of leakage along the shaft or around the bushing (see 4.8.13)

3.20 Marking.

3.20.1 Identification of product. Switches shall be marked in accordance with MIL-STD-1285 with the information specified in 3.20.1.1 and 3.20.1.2.

3.20.1.1 Switches covered by specification sheets.

- (a) Type designation.
- (b) Military part number (when applicable).
- (c) Manufacturers name or symbol
- (d) Electrical rating.
- (e) Date code.
- (f) Terminal and stop identification (see 3.1, 3.20.2, and 3.20.3).

3.20.1.2 Switches not covered by specification sheets:

- (a) Manufacturer's part number.
- (b) Manufacturer's name or trademark or Contractors and Government Entity (CAGE) code for manufacturers.
- (c) Terminal and stop identification (see 3.1, 3.20.2, and 3.20.3).
- (d) Electrical rating
- (e) Date code.

3.20.2 Terminal identification. Unless otherwise specified (see 3.1), switch terminals shall be marked with letters, whose sequence is counter-clockwise when viewed from the rear end of the switch. The terminal marking shall be on both sides of the barrier. The marking shall be in a contrasting color that allows for ease of identification in all lighting conditions. The markings shall be a minimum of 0.125 inch in height

3.20.3 Stop identification. Unless otherwise specified (see 3.1), switch stop positions shall be marked with numbers, whose sequence is clockwise when viewed from the rear end of the switch. The marking shall have a minimum height of 0.06 inch and be stamped or engraved into the plate containing the stop-screw holes.

3.21 Workmanship. Switches shall be processed in such a manner as to be uniform in quality and shall be free from cracked or displaced parts and other defects that will affect life, serviceability, or appearance. Molded or laminated parts shall be free of chips, blemishes, or flakes which are detrimental to the operating functions of the switch. Gate marks or flow lines shall not be considered a defect.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of

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the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements

4 1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system (see 6.3) or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of the manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.1.2 Calibration system. The supplier shall provide and maintain a calibration system in accordance with MIL-STD-45662.

4 2 Classification of inspections The inspection requirements specified herein are classified as follows.

- (a) Materials inspection (see 4 3).
- (b) Qualification inspection (see 4.5)
- (c) Quality conformance inspection (see 4.7).

4.3 Materials inspection. Materials inspection shall ensure that the materials listed in table I, used in fabricating the switches, are in accordance with the applicable referenced specifications or requirements prior to such fabrication. Failure to comply with the above requirements shall constitute rejection of all affected lots.

TABLE I. Materials inspection

Material	Requirement	Applicable document
Metal plating or treatment	3 4 1	MIL-C-83488, MIL-C-87155, ASTM B 63, QQ-N-290, or MIL-A-8625
Contact surface	3 4.1 1	QQ-S-365
Lubrication	3 4 1.4	MIL-G-23827
Insulation Plastic	3 4 2 1 and 3 4 2 2	MIL-M-14, MIL-P-15035, or MIL-P-15037
Fungus	3.4.2.3	MIL-STD-454

TABLE I. Materials inspection - Cont'd.

Material	Requirement	Applicable document
Flammable material	3.4.2.4	MIL-STD-454
Toxic and hazardous material	3.4.2.5	MIL-STD-454
Metals:		
Bronze	3.4.1.1	QQ-B-750
Copper	3 4 1 1	QQ-C-576

4.4 Inspection conditions. Unless otherwise specified herein, inspections shall be performed in accordance with the test conditions specified in the "General requirements" section of MIL-STD-202

4.5 Qualification inspection. Qualification inspection shall be performed at a laboratory satisfactory to the Naval Sea Systems Command (NAVSEA), on sample units produced with equipment and procedures normally used in production. Examination and tests shall be as specified in 4.5.1.

4.5.1 Samples for qualification. Six sample switches for qualification shall be selected in accordance with the detail specification sheet (see 3.1) or as specified (see 6.2). The test to be performed and the test sequence shall be in accordance with tables II and III.

Table II. Qualification inspection.

Examination	Requirement	Test method	Sample and test number					
			1	2	3	4	5	6
Visual and mechanical examination	3.3, 3.4 to 3.5.7 incl. 3.20 & 3.21	4.8.1	1	1	1	1	1	1
Circuit configuration	3.6	4.8.2	2	2	2	2	2	2
Torque	3.8	4.8.4	3	3	3	3	3	3
Terminal strength	3.9	4.8.5	4	4	4	4		
Dielectric withstanding voltage	3.10	4.8.6	5	5	5	5	4	4
Temperature rise	3.14	4.8.10	6	6				
Endurance	3.13	4.8.9	7	7				
Temperature rise	3.14	4.8.10	8	8				
Vibration	3.15	4.8.11			6	6		

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Table II. Qualification inspection - Cont'd

Examination	Requirement	Test method	Sample and test number					
			1	2	3	4	5	6
Shock	3 16	4.8.12						
Moisture resistance	3.17	4 8.13						
Strength of mounting bushing	3.7	4.8.3						
Seal (style JF)	3.19	4.8.15	9	9	9	9	6	6
Dielectric withstanding voltage	3 10	4.8.6	10	10	10	10	7	7
Insulation resistance	3.11	4 8.7	11	11	11	11	8	8
Contact resistance	3.12	4.8.8	12	12	12	12	9	9
Salt spray	3.18	4 8.14					10	10
Torque	3 8	4 8.4	13	13	13	13	11	11
Circuit configuration	3.6	4.8.2	14	14	14	14	12	12
Visual and mechanical examination	3.1, 3 4 to 3 5 7 incl 3.20 & 3.21	4.8.1	15	15	15	15	13	13

- 1/ Sample units shall include at least one switch of each rotor contact configuration.
- 2/ Samples 3 and 4 shall have the greatest number of sections listed in the applicable specification sheet.

Table III Extended approval

Column I Approved type	Column II Approval extended to type	Column III Except for test numbers 1/ 2/
Style JF	Style JM	5 and 6
Style JR	Style RJR and Style RJRA	5 and 6
Style JR	Style JR304	5 and 6
Style JR	Style JRM304	5 and 6

- 1/ Samples to be tested in accordance with table II
- 2/ Moisture resistance and salt spray tests shall not be required

4.5.2 Retention of qualification. In order to retain qualification, the supplier shall forward via the Government representative, at 12-month intervals, to the activity responsible for qualification, a summary of the results of group A and B tests performed during that interval, including the

number and type of any part failures. At three-year intervals, a summary of results of group C test shall be forwarded. Group B and C test reports shall be forwarded to the qualifying activity and shall include copies of original data sheets. Each summary and test report shall be validated by the Government quality assurance representative. If the test results indicate nonconformance with specification requirements, requalification will be required unless proof of corrective action for each failure is provided. Failure to submit the summaries will result in loss of qualification for that product. In addition to the periodic submission of inspection data, the suppliers shall immediately notify the qualifying activity at any time during the intervals that inspection data indicates failure of the qualified product to meet the requirements of the specification. In case there is no production during the intervals, a statement to this effect shall be forwarded to the qualifying activity.

4.6 Qualification inspection requirements for switches not covered by specification sheets. Qualification inspection requirements for switches not covered in 3.3.1 shall be performed by the supplier after award of contract and prior to full-scale production. Unless otherwise specified (see 6.2), inspection shall be as specified in 4.5

4.6.1 Samples Unless otherwise specified (see 6.2), the samples and test routine shall be as specified in 4.5.1 and table II. This acceptance is valid only on the contract under which it is granted unless extended by the Government to another contract. Samples subjected to this inspection shall not be delivered on the contract or order.

4.6.2 Failures. One or more failures shall be cause for refusal to grant inspection acceptance.

4.7 Quality conformance inspection.

4.7.1 Inspection of product for delivery. Inspection of product for delivery shall consist of groups A, B, and C inspection.

4.7.1.1 Inspection lot An inspection lot shall consist of switches of the same basic design, produced under essentially the same conditions, and offered for inspection at one time

4.7.1.2 Group A inspection. Sample switches shall be selected from each lot in accordance with table IV and the classification of defects in table V. Examinations and tests shall be conducted in the order listed.

TABLE IV. Group A inspection.

Examination or test	Requirement	Examination and test method	AQL (percent defective)	
			Major	Minor
Circuit configuration	3.6	4.8.2	1.5	---
Visual and mechanical examination	3.1, 3.4 to 3.5.7 incl 3.20 and 3.21	4.8.1	1.5	4.0
Dielectric withstanding voltage	3.10	4.8.6	1.5	---

TABLE V. Classification of defects

Categories	Defects
Critical. 1	Operating shaft not insulated from live circuits for protection against electric shock.
Major: 101 102 103 104 105 106 107 108 109 110 111 112	Type not as specified. Failure to comply with performance requirements. Chemical analysis of silver inlay, overlay and plating: Chemical composition not as specified Thickness of silver inlay, overlay and plating: Less than specified minimum. Switch unit not mounted for orientation to mounting plate as specified. Switch unit damaged or incomplete, marking missing, incorrect, or illegible. Evidence of drilling, countersinking, and tapping after plating or application of finish Materials less than minimum requirements; evidence of unauthorized materials used, evidence of cracks, splits, seams, or pitting. Threads nonconforming, form not as specified, not to size, missing, chipped, crossed, stripped, or damaged. Terminal screws and lockwashers missing, damaged or nonconforming. Sharp corners of switch unit components not rounded as required. Plating when specified nonconforming, missing, or incomplete, not smooth or uniform, evidence of peeling, nonadherent or uncoated areas, evidence of oxide scale or rust

TABLE V. Classification of defects (Cont'd)

Categories	Defects
Major.	
113	Switch unit operation, number of poles and positions, voltage, and contact rating not as specified.
114	Switch handle, shaft and blade action, rotation, and direction not as required; stops as applicable not positive or easily adjustable.
115	Switch not positive acting; spring assembly, or detent mechanism as applicable, not as specified, damaged or fails to operate as required; evidence of misalignment of switch unit shaft, evidence of sticking, binding, or excessive looseness
116	Detent mechanism, working parts of switch mechanism and contact areas of blades and terminals not lubricated as specified.
117	Mounting characteristics not as specified.
118	Handle missing, damaged, nonconforming, improperly fitted, and assembled.
119	Rotary identification plate missing, damaged or nonconforming; not painted as specified; not secured and positioned as required.
120	Component parts of switch not engraved, stamped, or lettered as required
121	Parts missing, damaged, nonconforming, improperly fitted, and assembled.
Minor:	
201	Preservation, packaging, and packing not as specified.
202	Marking and switch unit manufacturer's trademark or initials as applicable, missing, incorrect, illegible, not permanent, or not located as specified.

4.7 1.3 Sampling plan. As a minimum, the contractor shall inspect a sample quantity of switches in accordance with the sampling plan defined herein. Sample size depends on classification of the characteristic as shown in table V. The sample size for each characteristic is shown in table VI below. If one or more defects is found in any sample, the entire lot shall be rejected and screened 100% by the contractor for the defect found.

Table VI. Sampling plan.

Lot Size	Critical Characteristic	Major Characteristic	Minor Characteristic
2 to 8	All	All	3
9 to 15	All	All	3
16 to 25	All	20	3
26 to 50	All	20	5
51 to 90	All	20	6
91 to 150	125	20	7
151 to 280	125	20	10
281 to 500	125	47	11
501 to 1200	125	47	15
1201 to 3200	125	53	18
3201 to 10,000	192	68	22
10,001 to 35,000	294	77	29
35,001 to 150,000	294	96	29

4.7.1.4 Group B inspection Two switches of each contact configuration produced during each 12-month period following qualification shall be selected from the lot and subjected to the examination and tests specified in table VII in the order listed. If a specification sheet covers both positive detent and momentary action mechanisms, one sample shall be positive detent and one sample shall be momentary action. Samples selected shall have passed the group A inspection specified in 4.7.1.2. No samples are required for testing during the year that the group C tests are completed and submitted. Sample switches which have been subjected to group B inspection shall not be offered for delivery.

TABLE VII Group B inspection.

Examination or test	Requirement	Examination and test method
Visual and mechanical examination	3.1, 3.4 to 3.5.7 incl 3.20 and 3.21	4.8.1
Circuit configuration	3.6	4.8.2
Torque	3.8	4.8.4
Endurance	3.13	4.8.9
Temperature rise	3.14	4.8.10

TABLE VII. Group B inspection (Cont'd).

Examination or test	Requirement	Examination and test method
Contact resistance	3.12	4 8 8
Seal (Style JF only)	3.19	4.8 15
Dielectric withstanding voltage	3.10	4.8.6
Insulation resistance	3.11	4.8.7
Torque	3.8	4.8 4
Circuit configuration	3.6	4 8 2
Visual and mechanical examination	3.1, 3.4 to 3.5.7 incl. 3.20 and 3.21	4.8.1

4 7.2 Qualification verification inspection. Qualification verification inspection shall consist of group C inspection. Except where the results of these inspections show noncompliance with the applicable requirements (see 4 7 2.2), delivery of products which have passed groups A and B shall not be delayed pending the results of these qualification verification inspections.

4 7.2.1 Group C inspection. The number of sample switches shall be as specified in 4.5 1 and shall be submitted 36 months after the date of notification of qualification, and after each subsequent 36-month period. When production of a particular type of switch has been suspended for 24 months, sample switches shall be selected from the first lot of the new production following this period. The sample switches shall be subjected to the examination and tests specified in table II in the order listed. Samples selected shall have passed the group A inspection specified in 4.7.1 2 and shall be taken from production which occurred during the last year of the reporting period. Sample switches which have been subjected to group C inspection shall not be offered for delivery.

4.7.2.2 Noncompliance. If a sample fails to pass groups B or C inspection, the supplier shall take corrective action on the materials or processes, or both, as warranted, and on all units of product which can be corrected and which were manufactured under essentially the same conditions, with essentially the same materials, processes, etc., and which are considered subject to the same failure. Acceptance of the product shall be discontinued until corrective action, acceptable to the Government, has been taken. After the corrective action has been taken, group B or C inspection shall be repeated on additional sample units (all inspection, or the inspection which the original sample failed, at the option of the Government). Group A inspection may be reinstituted; however, final acceptance shall be withheld until the group B or C reinspection has shown that the corrective action was successful. In the

event of failure after reinspection, information concerning the failure and the corrective action taken shall be furnished to the cognizant inspection activity and the qualifying activity.

4.8 Examination and tests. Examination and tests shall be as specified in 4.8.1 through 4.8.15 (see 6.3).

4.8.1 Visual and mechanical examination. Switches shall be examined to verify that the design, construction, physical dimensions, marking, and workmanship are in accordance with the applicable requirements (see 3.1, 3.4 through 3.5.7, 3.20 and 3.21)

4.8.2 Circuit configuration (see 3.6) Switches shall be tested to determine conformance to the actual open and closed switch circuit conditions including shorting and nonshorting functions to the applicable diagram (see 3.1 and 6.2.). Each contact of each deck shall be tested. Suitable circuitry shall be used. Switches with adjustable stops shall be adjusted to give the maximum number of switching positions possible

4.8.3 Strength of mounting bushing (see 3.7). Bushing mounted switches shall be mounted on a metal panel using normal mounting means and hardware. A torque of 50 pound-inches shall be applied to the mounting nut on switches with 0.469 inch diameter bushings or larger and a torque of 25 inch pounds shall be applied to the mounting nut on smaller size bushings. The mounted switch body shall additionally be subjected to a torque of 5 inch pounds with the nonturn device mounted on the switch in the normal manner.

4.8.4 Torque (see 3.8). Switches shall be mounted by their normal mounting means.

4.8.4.1 Rotational The torque required to rotate the switch shaft with respect to the switch body shall be measured by a torque wrench or other torque measuring device. The switch shaft shall be rotated from each maintained position to the adjacent positions in both directions

4.8.4.2 Stops (applicable only to switches with stops). Unless otherwise specified (see 3.1), a torque of 100 inch-pounds shall be gradually applied to the shaft with the shaft in an extreme rotational position. Mating switch section contacts shall be monitored for opening or closing of contacts as required in the stop position

4.8.5 Terminal strength (see 3.9) The number of terminals tested shall equal the number of terminals in one deck and they shall be selected to include one terminal in each position and, where possible, not more than one terminal in each deck. If the number of positions exceeds the number of decks, additional terminals in each deck shall be tested to cover all positions

4.8.5.1 Pull. Unless otherwise specified (see 3.1), a force of 5 pounds shall be applied to the terminals at the normal location for attaching lead wires. The pull shall be gradually applied and maintained for 10 seconds in each of the following mutually perpendicular directions:

- (a) Tangent to the deck.
- (b) Parallel to the switch axis.
- (c) Perpendicular to both the switch axis and the tangent to the deck.

4.8 5 2 Torque. Terminals of the switches shall be tested in accordance with method 211, test condition E, of MIL-STD-202, and shall be subjected to a torque of 7-1/2 inch-pounds, and shall be maintained for 10 seconds. This test shall be made on terminals previously subjected to the pull test. The torque shall be applied 10 times in each direction.

4.8.6 Dielectric withstanding voltage (see 3.10). Switches shall be tested in accordance with method 301 of MIL-STD-202. The following details shall apply:

- (a) The test voltage shall be 1200 volts root mean square (rms), 60 hertz (Hz) except that following the endurance tests the test voltage shall be 600 volt rms, 60 Hz.
- (b) Nature of potential - alternating current (ac).
- (c) For group A inspection, the test voltage shall be applied for 5 seconds. For qualification and groups B and C inspection, the test voltage shall be applied for 1 minute.
- (d) In each switch position, the test voltage shall be applied between open circuit contacts, and between closed contacts and noncurrent carrying parts.

4 8 7 Insulation resistance (see 3.11). Switches shall be tested in accordance with method 302 of MIL-STD-202. The following details shall apply:

- (a) Test condition - B.
- (b) Points of measurements - In each switch position, the test voltage shall be applied between open circuit contacts, and between closed contacts and noncurrent carrying parts.
- (c) For group B inspection, the test voltage shall be applied for 15 seconds. For qualification and group C inspection, the test voltage shall be applied for 1 minute.

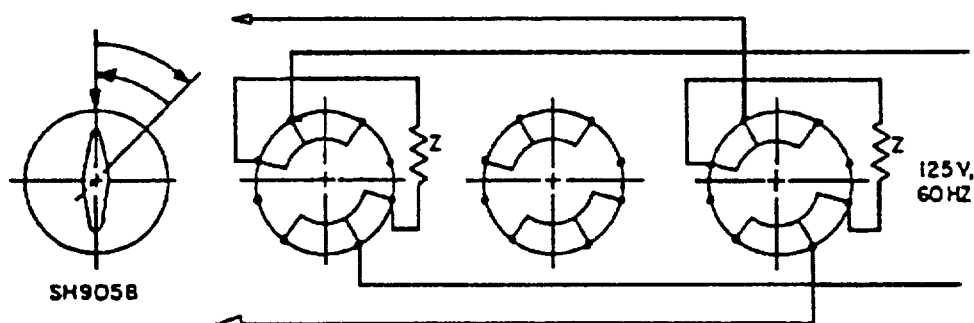
4 8 8 Contact resistance (see 3.12). Switches shall be tested in accordance with method 307 of MIL-STD-202. The following details and exceptions shall apply:

- (a) Method of connection - Test leads shall be connected by a method suitable for the switch terminals.
- (b) Test current - Rated current, except after mechanical endurance - 100 milliamperes (mA).
- (c) Maximum open-circuit voltage - Related voltage, except after mechanical endurance - 4 volts.
- (d) Number of activations prior to measurement - 1.
- (e) Number of measurements - Five separate measurements shall be taken and the average value calculated.

4.8.9 Endurance (see 3.13) Electrical and mechanical endurance tests shall be performed in the order as shown in 4.8.9.1 and 4.8.9.2. The contact resistance of each pole subjected to the electrical endurance test, and one pole in each deck not subjected to the endurance test, shall be determined as specified in 4.8.8 at the following times:

- (a) Before electrical endurance
- (b) After every 4,000 operations during electrical endurance
- (c) After electrical endurance.
- (d) After mechanical endurance.

4.8.9.1 Electrical Each deck or a maximum of five switching circuits in the switch shall make and break the rated load. These decks shall be distributed uniformly over the entire length of the switch. Switching shall be double-pole break as shown on figure 1. The switch shall be subjected to 40,000 cycles of operation. A cycle of operation is defined as the movement of the switch shaft from an open circuit position to an adjacent closed circuit position and return to the open circuit position. The cycling rate shall be approximately 30 cycles per minute (c/m) with equal periods of time in the open and closed positions. Switches shall be monitored to determine when any loaded contact fails to open or close in proper sequence.



Z - Rated impedance load

NOTE. Switch wiring shall be size 20 for less than 5 amperes and size 16 for 5 amperes or more. All leads from switch terminals to power supply or to load resistors shall be at least 2 feet long. Switch jumper wires shall be as short as practicable.

FIGURE 1. Typical load circuit for electrical endurance test

4.8.9.2 Mechanical The switch shall be operated without electrical load for 5,000 cycles of operation. A cycle of operation is defined as a complete rotation of the switch shaft through all switch positions. Where the switch has removable stops, the stops shall be removed and a cycle of operation shall be the full 360-degree rotation of the shaft. Where the switch has

nonremovable stops, the rotation of the shaft from the fully counter-clockwise position to the fully clockwise position and return shall constitute 2 cycles of operation. The cycling rate shall be approximately 15 c/m.

4.8.9.3 Momentary position return. Switches having momentary positions shall be operated to and released from each momentary position five times before and after the endurance operations.

4.8.9.4 Rotor and shaft alignment (see 3.5.3.3). For samples selected for the endurance test, the angle between the center of the detent position and the opening of the contacts shall be measured on break before make contacts of two terminals. The terminals shall be located on adjacent switch wafers. Three measurements shall be taken for each terminal and the average angle calculated for each terminal. The method of measurement shall provide for an accuracy of 15 minutes of angle.

4.8.10 Temperature rise (see 3.14). The temperature rise of the switch stationary contact energized during the electrical endurance tests shall be determined by means of thermocouples of small wire gage (28-32 AWG). The temperature sensitive element shall be placed on the contacts where they first emerge from the switch body. Temperature measurements shall be taken prior to and immediately following the electrical endurance test. The contacts shall be energized at rated current at any convenient voltage within the switch rating. Temperature measurements shall be taken at half-hour intervals until three successive measurements are within +/- plus or minus 1°C.

4.8.11 Vibration (see 3.15). Switches shall be tested in accordance with MIL-STD-167-1, type I. The following details and exceptions shall apply:

- (a) Test and measurements prior to vibration - Not applicable
- (b) Method of mounting - Switches shall be rigidly mounted by their normal mounting means. The mounting fixture shall be free from resonance over the test frequency range. Rear support shall be provided for style JL switches having 6 or more decks; for style JK switches having 11 or more decks, and for all other switches having 20 or more decks.
- (c) Direction of motion - One of the directions of vibration shall be in a plane perpendicular to the longitudinal axis of the switch.
- (d) Electrical test conditions - The test circuit shall be in accordance with method 310 of MIL-STD-202, and shall consist of one pair of closed mated contacts on each section. At the option of the manufacturer, contacts may be wired in series.
- (e) Test measurements during vibration - As specified in 4.8.11(d).
- (f) Measurements after vibration - Not applicable.
- (g) Examination after test - Switches shall be examined for change in shaft position, and evidence of broken, loose, deformed, or displaced parts.

4.8.12 Shock (see 3.16) Switches shall be tested in accordance with method 207 of MIL-STD-202. The following details and exceptions shall apply:

- (a) Mounting - Switches shall be mounted using the fixture on figure 207-4A for standard mounting fixtures for electrical-indicating switchboard meters and other panel-mounted parts of method 207 of MIL-STD-202. Rear support shall be provided for style JL switches having 6 or more decks, for style JK switches having 11 or more decks, and for all other switches having 20 or more decks.
- (b) Electrical test conditions - As specified in 4 8 11(d)
- (c) Measurements during shock - Switch contacts shall be monitored for opening at each blow.
- (d) Measurement after shock - Not applicable.
- (e) Examination after test - Switches shall be examined for change in shaft position, and evidence of broken, loose, deformed, or displaced parts.

4.8.13 Moisture resistance (see 3.17). Switches shall be tested in accordance with method 106 of MIL-STD-202. The following details shall apply.

- (a) Mounting - Switches shall be mounted on a corrosion-resistant metal panel with the shaft in the horizontal position.
- (b) Initial measurements - not applicable
- (c) Polarization - During steps 1 to 6 inclusive, a polarization voltage of 100 volts direct current (vdc) shall be applied between two terminals tied together on opposite sides and adjacent to a through bolt, or a terminal adjacent to a grounded metal portion if no through bolting is used, and the metal panel. Polarization voltage shall also be applied to two other adjacent terminals elsewhere on the switch section. One section of each switch shall be so tested. The negative polarity shall be applied to the metal panel
- (d) Steps 7a and 7b are not applicable.
- (e) Load voltage - Not applicable.
- (f) Final measurements - Immediately after the conclusion of the test and while the switches are still in the humidity chamber, insulation resistance shall be measured as specified in 4 8 7, unless otherwise specified (see 3 1). At the end of the drying period, insulation resistance shall again be measured as specified in 4 8.7, unless otherwise specified (see 3 1)

Within 24 hours after the test, the switches shall be examined for evidence of corrosion, breaking, cracking, spalling, or loosening of terminals. A movement of the terminal within the confines of the terminal anchoring device will be permitted provided continuity of electrical contact is not impaired. Mounting and terminal hardware shall be removable at the end of the test.

4.8.14 Salt spray (corrosion) (see 3 18). Switches with their mounting hardware, assembled with their mounting means, shall be tested in accordance with method 101 of MIL-STD-202. The following details shall apply.

- (a) Test condition - B.
- (b) Measurements after exposure - Not applicable.

After the test, switches shall be examined for evidence of excessive corrosion. Mounting and terminal hardware shall be removable at the end of the test.

4.8 15 Seal (applicable to style JF switches only) (see 3.19). Before conducting the test, all gaskets which can normally be replaced in service shall be disassembled from the switch and then reassembled with the switch. The switch shall then be mounted in a test enclosure by the switch's normal mounting facility and the test enclosure submerged under a 6-foot head of water, or submerged in water and subjected to external air pressure equivalent to a 6-foot head of water, for a period of 1 hour. During this test, the switch shaft shall be rotated through its normal travel limits at least five times. There shall be no evidence of leakage.

4.9 Inspection of packaging. Sample packages and packs, and the inspection of the preservation, packing and marking for shipment, stowage and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisition. For the extent of applicability of the packaging or preparation for delivery requirements of referenced listed in Section 2, see 6.9).

5 1 General.

5 1.1 Navy fire-retardant requirements.

(a) Treated lumber and plywood. When specified (see 6.2), all lumber and plywood including laminated veneer materials used in shipping container and pallet construction, members, blocking, bracing, and reinforcing shall be fire-retardant treated materials conforming to MIL-L-19140 as follows:

Levels A and B -	Type II - weather resistant Category I - general use.
Level C -	Type I - non-weather resistant Category I - general use.

(b) Fiberboard. Fiberboard used in the construction of interior (unit and intermediate) and exterior boxes including interior packaging forms shall conform to the class-domestic/fire retardant or class-weather resistant/fire retardant material requirements as specified (see 6.2), of PPP-F-320

5.2 Packaging requirements. The packaging (preservation, packing and marking) requirements shall be in accordance with MIL-S-28786 for the level of preservation, the level of packing, and marking and including bar coding and other packaging acquisition options therein as specified (see 6 2).

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use.

6.1 1 The switches covered by this specification are intended for use in communication and low power control equipment where reliability and ruggedness are required

6 1 2 No dc ratings are given for the switches included in this specification. The switches can be "teased" (slow movement of the rotor contacts making and breaking the stator contacts) and this "teasing" is highly destructive to contacts in switching dc loads. For 30-volt dc resistive loads, the maximum current interrupted by the switches should not exceed one-half that shown for the individual styles at 125 volts ac unless reduced switch life can be tolerated. For other dc applications, inquiries should be addressed to the command or agency concerned indicating the voltage, current, type of load and life expectancy in terms of cycles of operation.

6.2 Acquisition requirements Acquisition documents must specify the following

- (a) Title, number, and date of this specification.
- (b) Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1 and 2 2).
- (c) Title, number, and date of the applicable specification sheet and the type designation (see 3.1 and 6.6)
- (d) For switches covered by a specifications sheet but differing in number of sections, the number of sections required (see 3.3.1).
- (e) For types of switches not shown on a specification sheet, applicable complementary documents such as manufacturer's drawings or data sheets showing details of variations from the specification sheet (see 3.3 2).
- (f) Inspection requirements, if other than as specified in 4 6 (see 3.3.2).
- (g) Materials, if other than as specified (see 3.4).
- (h) Contact surface, if other than as specified (see 3 4.1.1)
- (i) Insulation, if other than as specified (see 3.4 2.1 and 3 4.2.2).
- (j) Design and construction (see 3.5)
- (k) Threaded parts, if other than as specified (see 3.5.1)
- (l) Mounting hardware (see 3.5.1.3 1)
- (m) Terminal hardware (see 3 5 1.3.2).
- (n) Knobs (see 3 5 1 3 3)
- (o) Whether stops are required and their positions (see 3 5 2)
- (p) Operating shafts (see 3 5 3)
- (q) Terminals (see 3 5 4).
- (r) Rotational torque (see 3 8.1)
- (s) Temperature rise (see 3.14)

- (t) Whether seal is applicable (see 3.19).
- (u) Marking (see 3.20)

Samples required for qualification, if necessary (see 4.5.1).

- (v) Inspection requirements:
To determine suitability of variations from qualified switch style, the procurement document should specify:
 - (1) Tests to be performed if other than specified (see 4.6).
 - (2) Data and samples to be submitted, if any (see 4.6.1)
- (w) Circuit configuration and diagrams to be used for specifying the circuit configuration for each switch section (see 4.8.2).
- (x) Terminal strength, if other than as specified (see 4.8.5)
- (y) Dielectric withstanding voltage:
 - (1) Test voltage, if other than as specified (see 4.8.6).
- (z) Endurance, if other than as specified (see 4.8.9.2).
- (aa) When fire retardant lumber and plywood is required (see 5.1.1 (a)).
- (bb) Class of fire retardant fiberboard required (see 5.1.1 (b)).
- (cc) Level of preservation, level of packing and other packaging options required (see 5.2).

6.3 Consideration of data requirements. The following data requirements should be considered when this specification is applied on a contract. The applicable Data Item Descriptions (DID's) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DID's are tailored to reflect the requirements of the specific acquisition. To ensure correct contractual application of the data requirements, a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DoD FAR Supplement 27.475-1 exempts the requirement for a DD Form 1423.

<u>Reference Paragraph</u>	<u>DID Number</u>	<u>DID Title</u>	<u>Suggested Tailoring</u>
4.8	DI-NDTI-80809	Test Reports	10.1.b

The above DID's were those cleared as of the date of this specification. The current issue of DoD 5010 12-L, Acquisition Management Systems and Data Requirements Control List (AMS DL), must be researched to ensure that only current, cleared DID's are cited on the DD Form 1423.

6.4 Qualification With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL No 21604 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Naval Sea Systems Command, SEA 51222, Department of the Navy,

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Washington, DC 20362-5101 and information pertaining to qualification of products may be obtained from that activity

6 5 Definitions. For the purpose of this specification, the definitions listed in 6.5.1 through 6.5.7 apply

6.5.1 Operating shaft. A journaled member which drives the rotating members of the switch.

6.5.2 Angle of throw. The number of degrees of rotation through which the shaft travels in moving from one position of the switch to the next consecutive position.

6 5.3 Shorting type switch. Also called make-before-break. When switching from one position to the next, the second contact is closed before the first is opened.

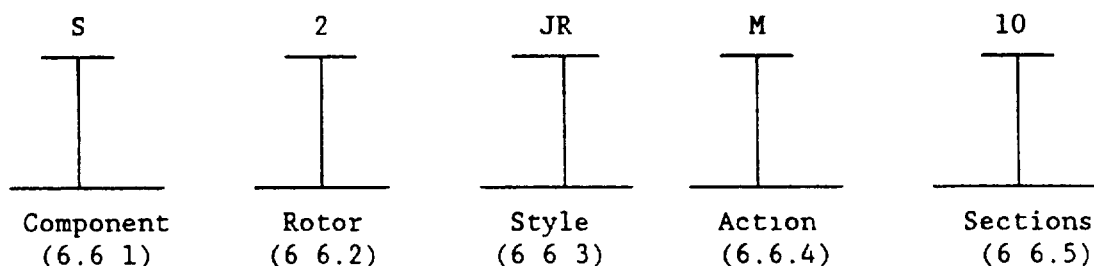
6.5.4 Nonshorting type switch. Also called break-before-make. When switching from one position to the next, the first contact fully breaks before the second contact is made.

6.5.5 Section or deck. That part of a switch complete in itself except for means of operating it, and consisting of a rotor and stator assembled as a unit with stationary and moving contacts.

6.5.6 Stator. The stationary insulating portion of the switch section

6 5 7 Rotor. An assembly of contacts and insulating hub.

6.6 Type designation. The type designation to be used for switches acquired to this specification is created as follows (see 3 3 1 and 6.2).



6 6.1 Component. The component designation for rotary switches covered by this specification shall be the letter S.

6 6.2 Rotor. The rotor designation shall be a single digit indicating the rotor contact configuration in accordance with figure 2 Rotor configurations 1, 2, 3, and 5 are break-before-make contact arrangements In changing switch positions, the closed circuit opens before the open circuit closes Configuration 4 is a combination break-before-make and make-before-break.

6.6.3 Style. The style shall be designated by two, three, or four letters and shall indicate the basic design, construction, and electrical ratings of the switches (see 3 1).

6.6.4 Momentary action. The designation "M" shall be used when the switch has one or more momentary positions.

6.6.5 Sections Unless otherwise specified, the sections designation shall be a figure indicating the actual number of sections, decks, or wafers with switching contacts thereon. This figure does not include decks provided for switch positioning by remotely controlled signals

DESIGNATION	CONFIGURATION	DESCRIPTION
1		SINGLE POLE DOUBLE BREAK
2		DOUBLE POLE DOUBLE BREAK
3		SINGLE POLE SELECTOR
4		DOUBLE POLE TRIPLE BREAK
5		TRIPLE POLE DOUBLE BREAK

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- 1/ With rotor configuration 4, contact H-1 breaks before C-3 makes, and contacts A-1 and B-2 make before A-2 and B-3 break

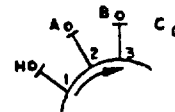


FIGURE 2 Rotor contact configuration

6.7 Intermetallic contact The finishing of metallic areas to be placed in intimate contact by assembly presents a special problem, since intermetallic contact of dissimilar metals results in electrolytic couples which promote corrosion through galvanic action. To provide the required corrosion protection, intermetallic couples are restricted to those permitted by table VIII. Table VIII shows metals and alloys (or plates) by groups which have common electromotive forces (EMF) within 0.05 volt when coupled with a saturated calomel electrode in sea water at room ambient temperatures. All members of a group are considered as completely compatible, one with the other. Compatible couples between groups have been specified in table VII based on a potential difference of 0.25 volt maximum. To simplify any arithmetic involved, table VII shows, in addition to EMF against a calomel electrode, a derived "anodic index" with group 1 (gold, etc.) as 0 and group

18 (magnesium, etc.) as 17 Subtraction of a lower group anodic index gives the EMF difference in hundredths of a volt.

TABLE VIII Compatible couples (see 6.7) 1/.

Group No	Metallurgical category	EMF 2/ (volts) ±0.05 volts	Anodic index (0 01V)	Compatible couples
1	Gold, solid and plated; gold-platinum alloys; wrought platinum (most cathodic)	+0.15	0	o ↓
2	Rhodium plated on silver-plated copper	+0.05	10	•o
3	Silver, solid or plated, high silver alloys	0	15	↓↓ ••o
4	Nickel, solid or plated, high nickel-copper alloys	-0.15	30	↓↓ ••o
5	Copper, solid or plated, low brasses or bronzes; silver solder; German silver, high copper-nickel alloys; nickel-chromium alloys, austenitic corrosion-resistant steels (passivated)	-0.20	35	 ↓↓↓ •••o
6	Commercial yellow brasses and bronzes	-0.25	40	•••o ↓↓↓
7	High brasses and bronzes; naval brass; Muntz metal	-0.30	45	•••o
8	18 percent chromium type corrosion-resistant steels	-0.35	50	••••o
9	Chromium, plated, tin, plated, 12 percent chromium type corrosion-resistant steels	-0.45	60	↓↓↓↓ ••••o
10	Tin-plate, terneplate, tin-lead solder	-0.50	65	↓↓↓↓ ••••o
11	Lead, solid or plated, high lead alloys	-0.55	70	↓↓↓↓ ••••o
12	Aluminum, wrought alloys of the duralumin type	-0.60	75	↓↓↓↓ ••••o
13	Iron, wrought, gray, or malleable; plain carbon and low alloy steels, armco iron	-0.70	85	↓↓↓↓ ••••o
14	Aluminum, wrought alloys other than duralumin type, aluminum, case alloys of the silicon type	-0.75	90	 ↓↓↓↓ ••••o

TABLE VIII. Compatible couples (see 6.7) 1/ (Cont'd).

Group No	Metallurgical category	EMF 2/ (volts) ±0.05 volts	Anodic index (0.01V)	Compatible couples
15	Aluminum, cast alloys other than silicon type; cadmium, plated and chromated	-0.80	95o ↓
16	Hot-dip-zinc plate; galvanized steel	-1.05	120	•o ↓
17	Zinc, wrought; zinc-base die-casting alloys; zinc, plated	-1.10	125	•
18	Magnesium and magnesium-base alloys, cast or wrought (most anodic)	-1.60	175	•

6.7.1 Groups. Table VIII sets up 18 primary groups. It may be noted that neither the metallurgical similarity or dissimilarity of metals is the parameter for selection of compatible couples. All members within a group, regardless of metallurgical similarity, are considered inherently nonsusceptible to galvanic action when coupled with any member within the group; for example, such dissimilar metals as platinum and gold. Similarly, such basically dissimilar alloys as austenitic stainless steel, silver-solder, and low brass (all members of group 5) are inherently nonsusceptible when coupled together.

6.7.2 Compatibility graphs. Permissible couples series are shown in table VIII by the graphs at the right. Members of groups connected by lines will form permissible couples. A 0 indicates normally the most cathode member of each series, an o an anodic member, and the arrow indicates the anodic direction.

6.7.3 Selection of compatible couples. Proper selection of metals in the design of equipment will result in fewer intermetallic contact problems. For example, for sheltered exposure, neither silver nor tin require protective finishes. However, since silver has an anodic index of 15 and tin 65, the EMF generated as a couple is 0.50 volt, which is not allowable by table VIII. In this case, other metals, plating, or electrical insulation will be required. It should be noted that, in intermetallic couples, the member with the higher anodic index is anodic to the member with the lower anodic index and will be susceptible to corrosion in the presence of an electrolytic medium (sea water). If the surface area of the cathodic part is significantly greater than that of the anodic part, the corrosive attack on the contact area of the anodic part may be greatly intensified. Material selection for intermetallic contact parts, therefore, should establish the smaller part as the cathodic member of the couple, whenever practicable.

6.7.4 Plating. When base metals intended for intermetallic contact form couples not allowed by table VIII, they are to be plated with those metals which will reduce the potential difference to that allowed by table VIII.

6.8 Subject term (keyword) listing.

Circuit
Contacts
Resistance
Rotor
Terminal
Voltage

6.9 Sub-contracted material and parts The packaging or preparation for delivery requirements of referenced documents listed in section 2 do not apply when material and parts are procured by the contractor for incorporation into the equipment and lose their separate identity when the equipment is shipped.

6.10 Changes form previous issue Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Preparing activity
Navy - SH
(Project 5930-N680)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

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I RECOMMEND A CHANGE:

1 DOCUMENT NUMBER
MIL-S-21604D(SH)

2 DOCUMENT DATE (YYMMDD)
92-03-30

3 DOCUMENT TITLE

SWITCHES, ROTARY, MULTIPOLE AND SELECTOR; GENERAL SPECIFICATION FOR

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

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b. ORGANIZATION

c. ADDRESS (Include Zip Code)

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(2) AUTOVON
(If applicable)

7. DATE SUBMITTED
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a. NAME Technical Point of Contact (TPOC):
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